The Hazard Analysis and Critical Control Points (HACCP) Generic Model for the Production of Thai Fermented Pork Sausage (Nham)

Kwantawee V. Paukatong and Sukun Kunawasen

National Center for Genetic Engineering and Biotechnology, National Science and Technology Development Agency, 73/1 Rama 6 Road, Rajthevee, Bangkok 10400 Thailand, Phone: 11-(662) 644-8150, Fax: 11-(662) 644-8105, E-mail: nob@biotec.or.th

Abstract: A Hazard Analysis and Critical Control Points (HACCP) generic model has been developed for the Thai fermented pork sausage or Nham process. Sodium nitrite, metal clip, and pathogens were identified as chemical, physical, and microbiological hazards in this product, respectively. Four steps in the Nham process have been identified as critical control points. These steps are the weighing nitrite, stuffing, fermentation, and labeling. Chemical hazard of nitrite must be controlled during weighing. Critical limit of nitrite levels in the Nham mixture has been set at 100 - 200 ppm. Physical hazard from metal clips could be prevented by visual inspection of every Nham product during stuffing. Microbiological hazard in Nham could be reduced in the fermentation process until the pH reach 4.6. Since this product is uncooked during processing, finally, educating the consumer, by providing safety information on the label, could be an alternative way to prevent the microbiological hazards of this product.

Keywords: control program, fermented food, pork safety, food safety

1. Introduction: The safety of food has become a crucial issue of concern for many consumers. Fermentation is a conventional food process that is practiced around the world. This process relies on the functions of different types of microorganisms. Normally, fermented food is considered to be safe due to the metabolites produced during the fermentation process. However, fermented food may contain pathogenic bacteria if the process does not result in proper metabolite production. Nham is a traditional Thai fermented pork sausage. Our previous surveillance study showed that of sixty samples of commercial Nham tested, 16%, 15%, and 12% were contaminated with *Salmonella* spp., *Staphylococcus aureus*, and *Listeria monocytogenes*, respectively. Therefore, Nham is a potential cause of foodborne diseases for consumers. Nham producers can enhance the safety of their product by producing Nham under the HACCP principle. The objective of this HACCP generic model is to provide the guidelines for Nham producers. This model was constructed based on the assumption that the prerequisite program has already been applied in their prodution. It should be also recognized that each Nham producer might have different ingredients and process steps. Therefore,

Nham producer needs to develop and adapt his own HACCP plan to suit their process operation.

2. Product descriptions: Nham is widely consumed in Thailand, especially in the northern part of country. The major ingredients of Nham are ground pork meat and shredded pork rind. The other ingredients are garlic, bird chili, salt, sugar, sodium nitrite, and cooked rice. Nham's ingredients were originally mixed by hand and then wrapped and fermented in banana leaves. Nowadays, plastic casing is widely used in Nham production.Nham is usually fermented naturally at room temperature ca. 30°C. The fermentation of Nham still depends on the natural mixed flora of lactic acid bacteria. Commercial Nham was found to have a pH in the range of 5.6-4.2, water activity in the range of 0.84-0.925, and a nitrite content lower than 125 ppm (Vichienroj and Kunawasen, 1998). Nham is usually served and consumed raw after 3-4 days of natural fermentation. Nowadays, there is no safety criterion for Nham product in Thailand. The process steps for Nham production are shown in Figure 1. This process flow diagram was constructed based on the production process of four Nham processing plants around Bangkok area and one plant in Chieng Mai.

3. Hazard Identification: The identified physical hazard is metal clips. During stuffing, a metal clip is used to seal the Nham product. Metal may have a chance to contaminate the product and cause a hazard to the consumer. Nitrite compound is considered as a chemical hazard in Nham product. Sodium nitrite is usually used as an ingredient of Nham to enhance the red color of product. Moreover, nitrite also assists in controlling the growth of *Clostridium botulinum*. One hundred-ppm was reported to be a minimum concentration of nitrite to present the inhibitory effect (Anon, 1974). However, nitrite can react with secondary and tertiary amines in the pork resulting in carcinogenic nitrosamine. The maximum allowance of nitrite compound added to meat product is set at 200 ppm with the nitrite residue in the product set at not more than 125 ppm (Codex Alimentarius Commission, 1993). There are several pathogenic bacteria, which are identified as the microbiological hazards in Nham product. Nham has been reported to be contaminated with *Salmonella* spp. (Swetwiwathana and Bangtrakulnonth, 1996; and Vichienroj and Kunawasen, 1998), *Staphylococcus aureus*, and *Listeria monocytogenes* (Vichienroj and Kunawasen, 1998). *Clostridium botulinum* is also considered as a microbiological hazard in this product because Nham is packed under anaerobic condition. *Cl. botulinum* could survive and grow in Nham if the process does not contain adequate acidity and nitrite level. Since thermal processes are not involved in Nham production, control of acidity during fermentation would be the best way to prevent the microbiological hazards in Nham product. However, consumers should thoroughly cook Nham before consumption.

4. HACCP plan of Nham Production: Critical control points (CCP) are the process steps which, if properly controlled, can prevent, eliminate, or reduce hazards to an acceptable level. Four steps of Nham process were identified as CCP by using a CCP decision tree, as shown by Mortimore and Wallace, 1994. Critical limits (CL) associated with each CCP is then set. Monitoring procedures are set up at each CCP, to perceive whether the process is out of control. If the operation process at CCP is deviated from CL, the corrective action is planned to adjust this deviation. All of the production steps at CCP, hazards, CL, monitoring procedures, and preventive measures summarized in Table 1.

5. Conclusion: This HACCP generic model provides the guideline for Nham producers to develop their own HACCP plan. The implementation of HACCP program in Nham industry would enhance the safety of this product. This is the first step for stimulating the safety concern of Thai traditional food producers.

Acknowledgements: The authors thank the National Center for Genetic Engineering and Biotechnology and National Food Institute, Thailand, for a research grant.

References

Anon, M.C. (1974): Annual Reports Meat Research Institute, Bristol, 1972-73, pp.11-12.

Codex Alimentarius commission. (1993): Codex Alimentarius volume ten: Meat and meat products including soups and broths. The Secretariat of the Joint FAO/ WHO Food Standards Programme. Rome, Italy.

Codex Alimentarius commission. (1999): Codex Alimentarius: Food Hygiene, Basic Texts. The Secretariat of the Joint FAO/ WHO Food Standards Programme. Rome, Italy.

Mortimore, S. and C. Wallace (1994): HACCP: A practical approach. London: Chapman & Hall.

Swetwiwathana, A. and A. Bangtrakulnonth (1996): Evaluation of Salmosyst enrichment procedure pus rambach agar for detection of salmonellae in Nham. The 34th Annual Conference Proceeding, Kasetsart University, Thailand.

Vichienroj, K. and S. Kunawasen (1998): Physical, chemical, and microbiological characteristics of Thai fermented sausage or Nham. In: Proceeding of the 4th Asia Pacific Food Analysis **Nham** Conference, 16-19 November, Chieng Mai, Thailand, pp. 186-187.

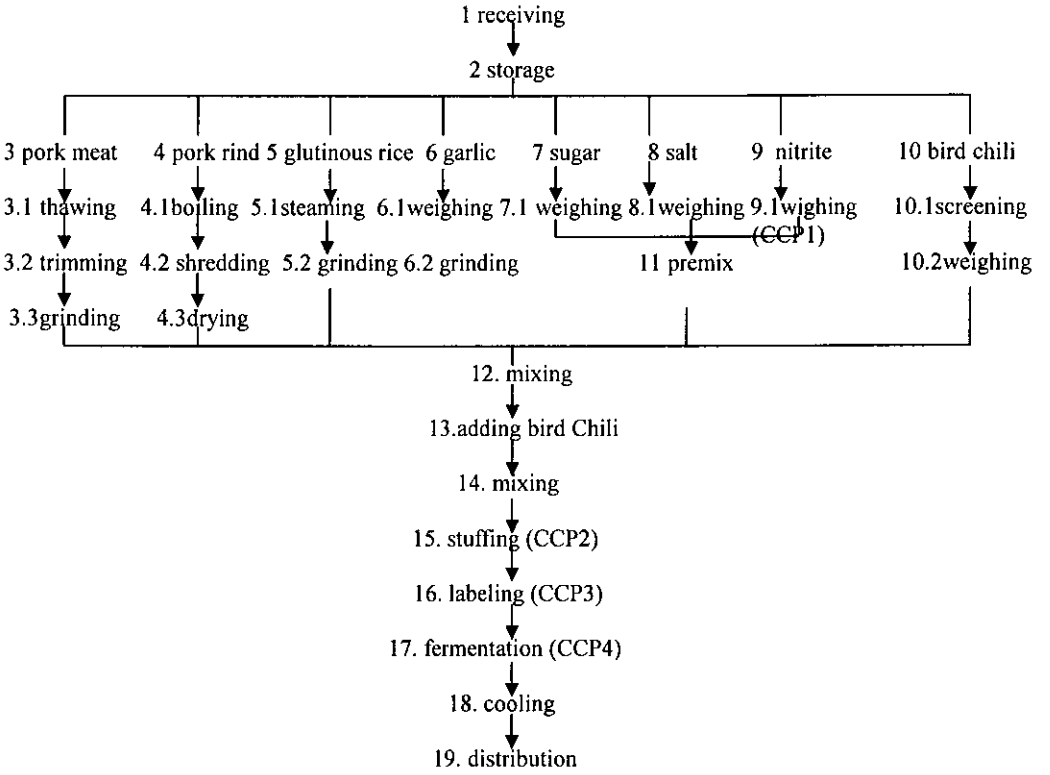

Figure 1. Process flow diagram of Nham production

Table 1. HACCP plan for the production of

Process Step	Hazard	Critical Limits	Monitoring Procedures	Corrective Actions
#9.1 weighing nitrite (CCP1)	Improper weigh nitrite: if the level too high resulting in chemical hazard, if the level too low resulting in microbiological hazard	100 ppm ≤ initial nitrite level ≤ 200 ppm	Q.C. supervisor random check the pre-weighed nitrite according to appropriate sampling frequency	- Supervisor reweigh every bag of nitrite since last satisfactory check, record deviation - Recalibrate the balance
#15 stuffing (CCP2)	Failure to remove metal clips contaminate in product	No metal in product	Line worker visual inspect each Nham product during stuffing and change worker every 30 min	Line worker notifies supervisor, separate contaminated product, segregate metal, and record deviation
#16 labeling (CCP3)	Failure to provide the microbiological safety information to consumer	Contain safety information such as "safe if cooked before consumption" on each Nham product	Line worker random visual check the label on Nham product	Line worker notifies supervisor, recheck Nham product since the acceptable check, label product, and record deviation
#17 fermentation (CCP4)	Inadequate fermentation resulting in growth of pathogens	The pH of Nham product is lower than 4.6	Q.C. worker random monitor pH of Nham in every lot	Q.C. worker notifies supervisor, hold lot, prolong fermentation, and record deviation